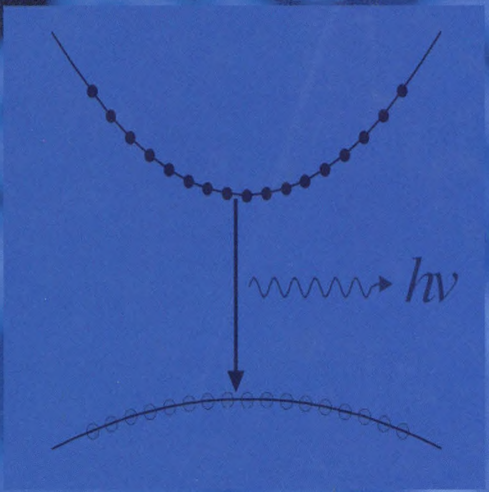
AMNON YARIV
POCHI YEH

PHOTONICS

OPTICAL ELECTRONICS IN MODERN COMMUNICATIONS



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Optical Electronics in Modern Communications

SIXTH EDITION

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Preface

The field of photonics, sometimes referred to as optical electronics, has continued to evolve vigorously during the last decade, thus justifying a major updating of the last (fifth) edition. The present edition has a broader theoretical underpinning and includes new and important subjects.

The book continues the tradition of introducing basic principles in a systematic self-contained treatment with minimal reliance on outside sources. It describes the physics and methodology of operation of the basic optoelectronic components of importance to optical communications and optical electronics. The book is intended to serve both as a text for students in electrical engineering and applied physics as well as a reference book for engineers and scientists working in those fields.

The present edition reflects two major efforts on our part: (1) the addition of new topics related to technology development in optical electronics and communications (and the omission of some less important topics) and (2) the refinement and improvement of materials already in the fifth edition. In the revision process, we decided to tailor the new edition for students, researchers, and engineers in the area of optical communications who are interested in learning how to generate and manipulate optical radiation and how to put this knowledge to work in analyzing and designing photonic components for the transmission of information. The presentation and inclusion of topics also reflect comments and suggestions from many anonymous reviewers and instructors.

Specifically, the main new features of this edition are:

1. The introduction of Stokes parameters and the Poincaré sphere for the representation of polarization states in birefringent optical networks.
2. The use of Fermat's principle for the derivation of rays, beam propagation, and the Fresnel diffraction integral.
3. The use of matrix methods for treating wave propagation in coupled resonator optical waveguides (CROWs).
4. Matrix treatment of multicavity etalons and multilayer structures.
5. Matrix treatment of mode coupling and supermodes in mode-locked lasers.
6. Chromatic dispersion, polarization mode dispersion (PMD) in fibers, and their compensation.
7. Nonlinear optical effects in fibers: self-phase modulation, cross-phase modulation, stimulated Brillouin scattering (SBS) and stimulated Raman scattering (SRS) in fibers, optical four-wave mixing, and spectral reversal (phase conjugation) in fibers.
8. Electroabsorption and waveguide electro-optic Mach–Zehnder modulators.
9. Periodic layered media, fiber Bragg gratings and photonic crystals, and Bragg reflection waveguides.
10. Optical amplifiers: semiconductor optical amplifiers, erbium-doped fiber amplifiers, and Raman amplifiers.

As in the earlier editions, we assume a basic background in electromagnetic theory and familiarity with Maxwell's equations and electromagnetic wave propagation in the bulk and in waveguides. An elementary acquaintance with quantum mechanics is recommended but may be acquired en route.

A generous use of numerical examples is intended to help bridge the gap between theory and applications.

The authors thank their students and colleagues as well as the many reviewers and lecturers whose comments constituted an important factor in the revision.

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